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DOCUMENT
PfP(CPG-S/3)D/20

STANAG 4423
(Edition 1)
(Ratification Draft 1)

GROUP ON SAFETY AND SUITABILITY FOR SERVICE OF MUNITIONS AND EXPLOSIVES (AC/310)

CNAD Partnership Group (CPG)

Submission for Approval of STANAG 4423 (Edition 1) "CANNON AMMUNITION (12.7 TO 40 MM) – SAFETY AND SUITABILITY FOR SERVICE EVALUATION"

Note by the Secretary

Reference: PfP(CPG-S/3-SG/4)DS/5, dated 10th May 2000

1. STANAG 4423 (Ed.1) Ratification Draft 1 has been submitted by Sub-Group 4, at reference, for AC/310 Main Group approval and initiation of the ratification procedure.

2. Main Group Members are requested to review the subject STANAG and to provide comments or proposed amendments to the Secretary within 3 months of the date of this document.

3. Main Group Members of NATO nations will be invited to approve STANAG 4423 (Ed.1) Ratification Draft 1 for circulation to nations for ratification at the December 2000 Main Group meeting.

(Signed) R. SLADDEN

Annex. 0
Enclosure: 1

Action Officer. Mr. Richard Sladden. ext. 4290
Original: English
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NORTH ATLANTIC TREATY ORGANIZATION
(NATO)

MILITARY AGENCY FOR STANDARDIZATION
(MAS)

STANDARDIZATION AGREEMENT
(STANAG)

SUBJECT: CANNON AMMUNITION (12.7 TO 40 MM), SAFETY AND SUITABILITY FOR SERVICE EVALUATION

Promulgated on

A. GRØNHEIM
Major General, NOAF
Chairman, MAS

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RECORD OF AMENDMENTS

No	Reference/date of amendment	Date entered	Signature

EXPLANATORY NOTES

AGREEMENT

1. This NATO Standardization Agreement (STANAG) is promulgated by the Chairman MAS under the authority vested in him by the NATO Military Committee.

2. No departure may be made from the agreement without consultation with the tasking authority. Nations may propose changes at any time to the tasking authority where they will be processed in the same manner as the original agreement.

3. Ratifying nations have agreed that national orders, manuals and instructions implementing this STANAG will include a reference to the STANAG number for purposes of identification.

DEFINITIONS

4. Ratification is "In NATO Standardizaton, the fulfilment by which a member nation formally accepts, with or without reservation, the content of a Standardization Agreement" (AAP-6).

5. Implementation is "In NATO Standardization, the fulfilment by a member nation of its obligations as specified in a Standardization Agreement" (AAP-6).

6. Reservation is "In NATO Standardization, the stated qualification by a member nation that describes the part of a Standardization Agreement that it will not implement or will implement only with limitations" (AAP-6).

RATIFICATION, IMPLEMENTATION AND RESERVATIONS

7 Page (iii) gives the details of ratification and implementation of this agreement. If no details are shown it signifies that the nation has not yet notified the tasking authority of its intentions. Page (iv) (and subsequent) gives details of reservations and proprietary rights that have been stated.

FEEDBACK

8. Any comments concerning this publication should be directed to NATO/MAS - Bvd Leopold III, 1110 Brussels - BE.

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RATIFICATION AND IMPLEMENTATION DETAILS
STADE DE RATIFICATION ET DE MISE EN APPLICATION

NATION / PAYS	NATIONAL RATIFICATION REFERENCE REFERENCE DE LA RATIFICATION NATIONALE	NATIONAL IMPLEMENTING DOCUMENT DOCUMENT NATIONAL DE MISE EN APPLICATION	IMPLEMENTATION/MISE EN APPLICATION					
			INTENDED DATE OF IMPLEMENTATION DATE ENVISAGEE DE MISE EN APPLICATION			DATE IMPLEMENTATION WAS ACHIEVED DATE EFFECTIVE DE MISE EN APPLICATION		
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RESERVES/RESERVATIONS

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NAVY/ARMY/AIR

NATO STANDARDIZATION AGREEMENT
(STANAG)

CANNON AMMUNITION (12.7 TO 40 MM), -SAFETY AND SUITABILITY FOR SERVICE EVALUATION.

Annexes: A Safety Tests of Cannon Ammunition.
B Supplementary Safety and Environmental Tests of Cannon Ammunition.

Related Documents:

AECP-1	Mechanical Environmental Conditions to which Material Intended for Use by NATO Forces could be Exposed.
AECTP-300	Climatic Environmental Tests.
AECTP-400	Mechanical Environmental Tests.
AEP-9 Vol. V	NATO Manual of Simulators of Nuclear Weapon Effects- Simulators of Electromagnetic Pulse (EMP) Effects.
AEP-18	EMP Test Methods and Procedures.
AEP-22	A Guide to Transient Radiation Effects on Electronics at the Technical Level.
AOP-15	Guidance on the Assessment of the Safety and Suitability for Service of Munitions for NATO Armed Forces.
AOP-24	Electrostatic Discharge, Munition Assessment and Test Procedures.
AOP-25	Lightning, Munition Assessment and Test Procedures.
AOP-39	Insensitive Munitions (MURAT) Requirements for Assessment Testing and Evaluation.
STANAG 1307	Maximum NATO Naval Operational Electromagnetic Environment Produced by Radio and Radar.
STANAG 2401	Heavy Weapons Range Safety Criteria.
STANAG 2895	Extreme Climatic Conditions and Derived Conditions for Use in Defining Design/Test Criteria for NATO Forces' Material.
STANAG 4110	Definition of Pressure Terms and their Inter-Relationship for Use in the Design and Proof of Cannons and Ammunition.
STANAG 4145	Nuclear Survivability Criteria for Armed Forces Material and Installations - AEP-4.
STANAG 4147	Chemical Compatibility of Ammunition Components, Explosives and Propellants (Non-Nuclear Applications).
STANAG 4157	Fuzing Systems Safety and Suitability for Service Use, Test Methods, Procedures and Qualification Criteria.

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STANAG 4170	Principles and Methodology for the Qualification of Explosives Materials for Military Use.
STANAG 4187	Fuzing Systems - Safety Design Requirements.
STANAG 4224	Large Calibre Artillery and Naval Gun Ammunition Greater than 40 mm, Safety and Suitability for Service Evaluation.
STANAG 4234	Electromagnetic Radiation (Radio Frequency) - 200 kHz to 40 GHz Environment - Affecting the Design of Material for Use by NATO Forces.
STANAG 4235	Electrostatic Environmental Conditions Affecting the Design of Material for Use by NATO Forces.
STANAG 4236	Lightning Environmental Conditions Affecting the Design of Material for Use by NATO Forces.
STANAG 4239	Electrostatic Discharge, Munition Test Procedures.
STANAG 4240	Liquid Fuel Fire Test for Munitions.
STANAG 4241	Bullet Attack Test for Munitions.
STANAG 4242	Vibration Test Methods and Severities for Munitions Carried in Tracked Vehicles - AOP-34.
STANAG 4315	NATO Ageing and Life Time Test Procedures for Munitions.
STANAG 4324	Electromagnetic Radiation (Radio Frequency) Test Information to Determine the Safety and Suitability for Service of Electro-explosive devices and associated electronic systems in Munitions and Weapon systems.
STANAG 4327	Lightning, Munition Assessment and Test Procedure.
STANAG 4370	Environmental Testing (Covering AECTP 300 and 400.)
STANAG 4375	Safety Drop, Munition Test Procedure.
STANAG 4382	Slow Heating, Munition Test Procedures.
STANAG 4396	Sympathetic Reaction, Munition Test Procedure.
STANAG 4416	Nuclear Electromagnetic Pulse, Munition Test Procedure.
STANAG 4439	Policy for Introduction, Assessment and Testing for Insensitive Munitions (MURAT).
STANAG 4516	Cannon (above 12.7 to 40 MM) Design Safety Requirements and Safety and Suitability for Service Evaluations of Weapon/Munition Interface.

AIM

1. The aim of this agreement is to standardize the process for assessment and testing to support the evaluation of the safety and suitability for service of cannon ammunition.

AGREEMENT

2. Participating nations agree that environmental and safety testing (including adequate documentation), performed in accordance with this STANAG, is valid for evaluation. Further, they agree that the results of environmental and safety tests of cannon ammunition performed in accordance with this document will be provided by the developing nation to participating nations upon a valid request.

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DEFINITIONS

3. a. Cannon. A cannon is defined as an automatic gun, capable of a sustained rate of fire in excess of about 100 rounds per minute, with a calibre between 12 7 mm and 40 mm. together with any associated ammunition feed mechanism essential to enable the gun to execute automatic fire, loading and/or (re)firing operations.

b. Cannon Ammunition. Cannon ammunition is defined as that ammunition which is designed to be loaded into and fired from a cannon

GENERAL

4. The purpose of environmental and safety testing is to provide the evidence for the evaluation of cannon ammunition, with its associated packaging where appropriate, to provide confidence that:

a. The cannon ammunition will remain safe and suitable for service and will function within specified performance limits after being exposed to severe handling and extreme climatic conditions equivalent to those which are likely to be found during storage, transportation, stowage and operation during the entire service life of the munition, including disposal.

b. The risk of an unintentional explosive event occurring at any point throughout the service life is acceptably low. For example, hazards may arise during functioning of the cannon in credible accidents, as a result of enemy action or during disposal.

c. There is no damaging interaction between the weapon system platform, structure and the cannon, the cannon ammunition and/or the associated packaging, when subjected to service conditions.

DETAILS OF THE AGREEMENT

5. Procedures. Each nation will be responsible for the evaluation, as defined in AOP-15, of safety and suitability for service of cannon ammunition to be used by its own Services and for this purpose will require copies of the design characteristics, safety analyses and trial reports from the nation responsible for the development of the cannon ammunition being evaluated. The nations carrying out the evaluation of safety and suitability for service on a particular cannon ammunition agree to make their test parameters, safety analyses and trials reports available to other NATO nations intending to purchase or to take over the ammunition, on valid request.

6. Variations on the Procedures:

a. Notwithstanding the intention to avoid duplication of testing, each nation reserves the right to carry out additional testing if considered appropriate and, when necessary, to bear the financial costs of so doing.

b. Any significant changes proposed to the evaluation procedures defined in this document will be provided to the user nation for comment and concurrence; any changes made without the mutual acceptance of the ratifying nations may negate the acceptability to the user nations of the above mentioned agreed evaluation procedures.

c. The service environment to which the cannon ammunition may be subjected will be specified by the user nation. The specific test programme need not be limited to tests described in this document. The selection of tests, test parameters and test sequences shall be based on hazard analysis and the measured, or analytically forecast environmental life cycle profile of the test item, as indicated in AOP-15, to optimize detection possibilities of the expected failures.

d. No individual tests or group of tests in isolation can be used to evaluate fully the safety of a munition. It is agreed that the final national safety evaluation shall take account of the development trials, as well as its individual safety requirements, in order to make a valid evaluation of the cannon ammunition in the specific national service environment.

SAFETY TESTING OF EXPLOSIVES

7. The safety characteristics of the explosives selected for use in cannon ammunition shall be established in accordance with STANAG 4170 and national requirements where those national requirements are more severe. The compatibility of all materials shall also be assessed in accordance with STANAG 4147.

CANNON AND AMMUNITION INTERACTION

8. Cannon ammunition may be required to be fired from a number of different types of cannon of the same calibre. The evaluation of such ammunition will need to take account of each set of weapon design criteria (e.g. chamber characteristics) and the environment likely to be seen by the ammunition when being cycled through the cannon feed mechanisms. Consequently it cannot be assumed that a round of ammunition that complies with this STANAG will function safely and satisfactorily in all other cannons of that calibre. Requirements for interchangeability of cannon ammunition are given in STANAGs 1402 and 1405/AOP-27 (Navy), STANAGs 2928/AOP-6 and 4425/AOP-29 (Land), or STANAG 3791/AOP-11 (Air).

PRESSURE RELATIONSHIPS AND TERMINOLOGY

9. The pressure relationships and terminology detailed in STANAG 4110 are relevant and are to be applied to cannon ammunition in this STANAG.

ENVIRONMENTS

10. Environments which shall be considered for the assessment and testing of cannon ammunition should be selected using the questionnaire at Annex A to AOP-15 and are summarised as:

a. Natural environments created regardless of human intervention, e.g. temperature, pressure, humidity, sand, lightning or salt spray.

b. Induced environments associated with the handling and transportation of ammunition from manufacture, through storage to loading into deep or ready use magazines or stowages in a ship, vessel, aircraft, fighting vehicle, or military installation.

c. Induced environments associated with installation and carriage on the weapon system platform, or with the ammunition feed system, including the process of loading and firing.

d. Induced electromagnetic, electrostatic and nuclear environments resulting from human intervention.

e. Hazardous environments associated with enemy action and accidents. e.g. fire, strike by other ordnance or fragments, aircraft crash, handling accidents, etc.

LIFE CYCLE

11. During a manufacture-to-target or disposal sequence (MTDS), cannon ammunition may encounter ground, sea and air environmental conditions. Within these environments, the ammunition, whether packaged or unpackaged, may be subjected to: storage; handling; testing; transportation by road, rail, sea and air; use in ships, vehicles and aircraft. The tests required to establish the safety and suitability for service characteristics of the ammunition shall take account of the need to demonstrate the effects of the expected environment on the ammunition during its expected life cycle in accordance with the Operational Requirement. The procedure for assessment of life is to be given in STANAG 4315 when published.

ENVIRONMENTAL SPECIFICATION

12. To ensure that the environments used during tests are representative, the anticipated environment shall be detailed so that it is consistent with the Operational Requirement and the design specification for the cannon system, i.e. certification that the anticipated environment has been correctly defined needs to be given by the appropriate Operational Requirements office of the developing nation's Service or Services. This process is defined in AOP-15.

OUTLINE OF ENVIRONMENTAL AND SAFETY TEST PROGRAMME

13. The environmental and safety test programme shall be developed for cannon ammunition based on hazard analysis and the environmental profile as indicated in Paragraphs 6c, 7, 10, 11 and 12. Such a programme will include both safety tests and supplementary tests, as described in Paragraph 14 below, and the construction of the test programme will include the sequencing of tests to match the MTDS. The selection of tests, test methods, parameters, duration and sequence shall be agreed with the Project Manager or delegated representative and the logic of these choices related to the specified environment shall be documented.

SAFETY AND SUPPLEMENTARY TESTS

14. The safety tests are those which shall be conducted satisfactorily to establish adequate safety during operation of the cannon and in credible accident situations; these are given in Annex A. The applicability of some of these tests is conditional upon the design of the particular ammunition and its intended use in a cannon. Supplementary tests are additional safety and environmental tests to provide further evidence to assess safety and suitability for service to survive a given environment within the specification; these are given in Annex B. All common or specific supplementary tests shall be considered when developing an environmental and safety test programme for cannon ammunition.

ADDITIONAL TESTS

15. Further tests, not included in Annex B, may be conducted if considered necessary by the developing authority. In particular, novel ammunition designs may require further tests to be undertaken

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INSENSITIVE MUNITIONS ASSESSMENT

16. When appropriate the safety assessment carried out on the ammunition shall take account of the requirements of STANAG 4439 and AOP 39

TEST PARAMETERS

17. Standard test procedures and test parameters are given in Annexes A and B Test severities shall be at least in accordance with the minimum requirements presented in or referred to in these Annexes. If the results of analyses lead to the requirement for more severe testing, or tests not mentioned in these Annexes, the appropriate severities or tests shall be included in the test programme. Nothing in this STANAG should prevent the developing or other nation deciding on a higher or more severe criterion if it so wishes. However, the developing nation should be consulted in the event that a more severe test is specified in case the test is outside the specified design parameters of the ammunition

TEST PROCEDURES

18. The tests described in Annex A shall be conducted in accordance with ratified test STANAGs. In those instances where appropriate STANAGs have not yet been ratified, national procedures will apply until superseded by ratified STANAGs. Items within the ammunition may be substituted by non-functional items provided this does not detract from the purpose of the test or the test sequence. Such configurations must be specified in the test plan and reported in the test report

CHOICE OF TESTS AND TEST SEQUENCE

19. Some or all of the environmental and safety tests within the programme are conducted sequentially to verify that the cannon ammunition will be safe and suitable for service in the expected environment. Such sequences may end with destructive functioning, destructive safety tests or destructive detailed examination. Rounds may be withdrawn at various points for detailed examination to ascertain the effects of specific environments. The detailed design of the cannon ammunition should be critically examined so that the sequence or sequences represent the best compromise between a realistic MTDS and those sequences which will cumulatively produce the most severe degradation of the rounds under test. The content of test sequences and the number of rounds involved will also be influenced by any similarities with previous designs or by technical innovation in the design.

RELATIONSHIP WITH DEVELOPMENT TESTING

20 Tests on cannon ammunition shall be classified as development or environmental and safety tests. It is expected that development tests will also cover the spectrum of tests in Annexes A and B as well as other tests. The essential differences between the 2 programmes are that ammunition selected for the safety and environmental test programme must be fully representative of the production standard and procedures and that such ammunition shall successfully pass the environmental and safety test criteria. The results of development trials carried out with ammunition or components representative of the production build standard may be taken into consideration in the evaluation of safety and suitability for service, providing test data are made available.

REPORTS ON ENVIRONMENTAL AND SAFETY TESTS

21. It is essential that adequate data be available to national/service safety evaluation organisations for the evaluation of cannon ammunition safety and suitability for service. Therefore nations developing the ammunition shall compile a data package which documents the test methods and rationale for the programme selection. Reports should be from accredited test ranges/authorities and carry a satisfactory assurance of quality. The package will also give the detailed results obtained during environmental and safety tests. Where results from development trials have been used to permit fewer rounds in the sequence or to reduce the duration of environmental tests, then the results of these development trials should also be included, providing the aspect of development munition under test has not been changed in the production version. This data package shall be supplemented by a technical design data package.

IMPLEMENTATION OF THE AGREEMENT

22. This STANAG is considered to be implemented when a nation has issued instructions that all new munitions procured for Service use as cannon ammunition will be tested in accordance with the procedures detailed in this agreement.

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ANNEX A to
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SAFETY TESTS OF CANNON AMMUNITION

1. SAFE FUNCTIONING

   a. Reason for Test. This test is conducted to demonstrate that the ammunition is sufficiently robust to be cycled through the cannon storage, feed, ramming and extraction mechanism, and that the fired projectile functions satisfactorily (remains intact and stable).

   b. Information. The test is designed to subject the ammunition to the most severe conditions to be encountered. Production standard ammunition is to be used. The test is to be undertaken with a service cannon and with a representative service ammunition feed system. Sub-calibre projectiles shall remain stable after discarding sabots/pushers. For aircraft mounted cannons, the effects of aircraft forward velocity may be simulated to evaluate the effects on projectile stability. Trajectories of discarding sabots and pushers and the effects of a full aircraft ammunition load firing in one burst should be considered. The test is repeated with new and worn cannon systems for each type of weapon system for which this ammunition is specified.

   c. Test Procedure. The test shall be conducted in accordance with national procedures.

2 STRENGTH OF DESIGN

   a. Reason for Test. This test is conducted to demonstrate the strength of design of the cartridge case and projectile assemblies.

   b. Information. Ammunition is to be loaded with special or overpressure charges to give projectile design pressure, as defined in STANAG 4110. Consideration may be given to using high twist barrels.

   c. Test Procedure. Test in accordance with STANAG 4224 Annex B [Edition 3] except for recovery and examination of projectile (excluding Paragraph 6, Sub-paragraphs a to e; Paragraph 7, Sub-paragraphs a, b and deformation from c). Include visual examination of cartridge cases after extraction and note any evidence of deformation, failure of obturation or hard extraction. Witness/target screens/plates or high speed photography may be used to examine the strength of the projectile.

3. PROPELLING CHARGE SAFETY

   a. Reason for Test. This test is conducted to verify that the Maximum Operating Pressure (MOP) generated by the propelling charge is lower than the cannon Permissible Maximum Pressure (PMP) for a specified projectile and cannon system.

   b. Information. Ammunition shall be subjected to preliminary environmental stressing. Ammunition that has been subjected to sequential environmental tests may be used for this purpose. The Ammunition is fired at the temperature giving rise to the maximum chamber pressure, in order to record the Extreme Service Condition

Pressure (ESCP). This will normally occur at the Upper Firing Temperature (UFT) as defined in STANAG 4110, but also taking due account of air carriage kinetic heating, and gun firing heating effects. The MOP is calculated from the ESCP by the method given in STANAG 4110. Additional firings may be required at intermediate firing temperatures to ensure linearity of temperature coefficients, or to determine the temperature at which Extreme Service Condrtions apply

c. Test Procedure. The test shall be conducted in accordance with STANAG 4224 Annex A [Edition 3], except that the Firing Interval is not required, a minimum of one pressure transducer is required and copper crushers need not be used at smaller calibres due to the small size of the round and chamber. Tests to be fired from 2 pressure barrels on 2 occasions, using no fewer than 2 propellant lots. Pressure and muzzle velocity are recorded for each shot.

4. HOT GUN COOK-OFF

a. Reason for Test. This test is conducted to determine the temperature at which the ammunition will cook-off. It is also to determine whether and, if so, when, cannon ammunition will cook-off when fed into a hot breech.

b. Information. The temperature of the store is raised rapidly to determine the temperature at which an event will occur. To establish whether cook-off occurs in the cannon system when in use, the cannon must be fired at the maximum rate of fire for a duration to be specified. Immediately afterwards, either a round is separately inserted, or a round with no primer fitted is fed into the breech. This is to simulate a misfire or other feed/firing system failure. If cook-off occurs, the temperature and time at which it occurs is recorded.

c. Test Procedure. The test shall be conducted in accordance with national procedures.

5. SAFETY DROP

a. Reason for Test. This test is conducted to determine the reaction of cannon ammunition to impact and whether it is safe to handle and dispose of by qualified personnel following impact from high accidental drops.

b. Information. This test simulates an accidental drop of ammunition in its packaging during ship loading (or unloading) for transport or use. The minimum height for this test is to be 12 m. The store will normally be dropped packaged onto an impacting surface of concrete, faced with a steel plate. As a minimum, one sample will be dropped so that the base of the packaged store impacts in the horizontal attitude. Munitions containing pyrotechnically initiated explosives (PIE) shall also be tested in the nose down attitude. This test should be carried out with ammunition in the packaging appropriate for logistic transportation. This is normally a pallet configuration or Unit Load Container. To avoid the expense of testing unnecessarily large quantities of ammunition, this test may be carried out with live ammunition in selected critical locations within the pallet configuration, and the remaining locations filled with ballasted containers. If it can be demonstrated that palletized ammunition will not be subjected to any unusual or additional strains over and above those experienced in individual containers then the tests may be

carried out on a single container. Under these circumstances, in the event of any form of failure affecting safety, the test is to be repeated with the full quantity of ammunition in the palletized load

c. Test Procedure. The test should be conducted in accordance with STANAG 4375. If study of the MTDS indicates that the height of drop may exceed 12 m for any known class of ship or vessel, after full allowance for clear lifting height and safety margins, then the test should be carried out at the greatest height assessed.

6. LIQUID FUEL FIRE

a Reason for Test. This test is conducted to determine the reaction of the cannon ammunition to an intense fire (e.g. aircraft/helicopter/vehicle crash).

b. Information. The quantity of fuel should be chosen to ensure that the duration of the fire is sufficient to cause reaction of the store. The severity and time to the reaction will be assessed. In most cases, the test criteria will require that the store does not detonate, or become propulsive during the test, and/or react within a given time. Ammunition may be packaged and/or unpackaged depending on the MTDS sequence.

c. Test Procedure. The test shall be conducted in accordance with STANAG 4240.

7 SLOW HEATING

a. Reason for Test. This test is conducted to determine the reaction of the cannon ammunition to increasing heat over a long period such as may result from a fire in an adjacent building or compartment.

b. Information. The temperature of the ammunition is raised gradually until a reaction occurs (or 310^{0}C is reached). The reaction of the round may be more severe than that observed during the Liquid Fuel Fire Test because the structure of the munition may provide containment for the explosives until a higher temperature is reached, or the explosive components may react differently to fast heating regimes.

c. Test Procedure. The test shall be conducted in accordance with STANAG 4382.

8. BULLET/FRAGMENT ATTACK

a. Reason for Test. This test is conducted to determine the reaction of the cannon ammunition to bullet attack and fragment strike.

b. Information. The test criteria shall specify the acceptable reaction of the round. It should not detonate, explode or become propulsive when struck by the specified test bullet types. A variety of bullet types may be specified, both to assess reaction to direct impact as a result of enemy/terrorist attack and to simulate fragments produced by detonation of other warheads. Any residue should remain safe for handling and disposal. Prior to this test, the ammunition may be subjected to an environmental conditioning sequence. Ammunition may be packaged and/or

unpackaged depending on the MTDS. Separate tests should be conducted with the test strike impact on the cartridge, fuze, and warhead filling, or their interfaces, as appropriate.

b. Test Procedure. The bullet impact test shall be conducted in accordance with STANAG 4241. Fragment attack tests to national procedures may also be used.

9. SYMPATHETIC REACTION

a. Reason for Test. This test is conducted to determine the reaction of the cannon ammunition to functioning of a round in close proximity.

b. Information. Sympathetic detonation between adjacent rounds in all MTDS configurations shall not occur. The test criteria may accept lesser reactions. Detonation propagation tests may be conducted and tests which may contribute information include Total Fragment Recovery Tests and Fragment Attack Tests.

c. Test Procedure. The test shall be conducted in accordance with STANAG 4396.

10. TOXIC CONTAMINANTS

a. Reason for Test. This test is conducted to determine whether any toxic products of firing could be a hazard to firing crews, vehicle crews or adjacent personnel

b. Information. To be carried out with the worst case wind speed and direction identified. For vehicle mounted weapons, to be carried out with all possible training and operational variations of hatches open/shut and NBC/ventilation on/off. For helicopter door mounted weapons, to be carried out with all permissible variations of closure of apertures. Samples to be collected in selected crew and adjacent personnel locations. Test may be carried out as part of Firing Tests. Results are to be assessed against national standards.

c. Test Procedure. The test shall be conducted in accordance with national procedures.

11. NOISE/MUZZLE BLAST

a. Reason for Test. This test is conducted to determine whether the blast overpresure generated by firing creates a noise hazard to the gun crew and adjacent personnel or an unacceptable hazard to structures.

b. Information. To be carried out without any adjacent structure to identify the basic noise danger area. To be repeated for each particular type of ship, vehicle or helicopter installation arrangement as appropriate to identify site variations caused by reflection and absorption. For vehicle or helicopter mounted weapons to be carried out with all possible training and operational variations of hatches/doors open/shut. Test may be carried out as part of Firing Tests. Results are to be assessed against national standards.

c. Test Procedure The test shall be conducted in accordance with national procedures.

12. FUZE SAFETY

a. Reason For Tests. These tests are conducted to verify the safety of the fuze in credible accident scenarios and in the environmental conditions to be encountered in the MTDS.

b. Information. Evidence will be required that the fuze complies with the requirements of STANAG 4187. Fuzes shall not function unintentionally in any single credible accident situation nor under any climatic, physical or mechanical environmental condition identified in the MTDS. Additional tests may be required on separately packaged fuzes and munitions containing PIEs.

c. Test Procedure. The tests shall be conducted in accordance with STANAG 4157. These include:

(1) Minimum Arming Distance Test.

(2) Rain Drop Impact Test.

(3) Muzzle Cover Test.

(4) Explosive Train Interrupt Test.

(5) Electrostatic Discharge (ESD) Test.

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ANNEX B to
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SUPPLEMENTARY SAFETY AND ENVIRONMENTAL TESTS OF CANNON AMMUNITION

1. LOGISTIC VIBRATION

   a. Reason For Test. This test is conducted to demonstrate that the cannon ammunition will remain safe and serviceable following transportation by sea, road, rail and air.

   b. Information. The real environment is a mixture of random and sinusoidal vibration. Sinusoidal vibration at low frequencies is dominant in transportation by ship, whereas random vibration is more significant in road and rail transport. Air transportation vibration is mainly random in nature but may have specific peak sine vibration at discrete frequencies, particularly in propeller driven aircraft and helicopters. The type of vibration testing selected must be chosen from the principal transportation modes in the MTDS. It may be necessary to carry out the selected vibration tests at appropriate high and/or low temperatures associated with transport modes.

   c. Test Procedure. Tests shall be conducted in accordance with AECTP 400 - Method 401.

2 LOGISTIC BOUNCE/SHOCK - REPETITIVE

   a. Reason For Test. This test is conducted to demonstrate that the cannon ammunition will remain safe and serviceable following repetitive shock loadings expected during transportation and/or handling.

   b. Information. Repetitive shocks may arise from road or rail transportation, or by handling in mechanical systems and roller conveyors. The severity, shape, direction, duration, frequency and number of shock test pulses will depend on the situation in the MTDS being simulated.

   c. Test Procedure. Tests shall be conducted in accordance with national procedures.

3 SHOCK - NON REPETITIVE

   a. Reason For Test. The test is conducted to demonstrate that the cannon ammunition will remain safe and serviceable following non repetitive shocks, multiple small drops or transient vibration expected during transport, handling and operation.

   b. Information. Shock, multiple small drops, transient vibration or horizontal impact may occur during transportation by road, rail or air, in mechanical handling systems, or during crane operations. They may arise by design during use (e.g catapult launch/arrested landing). The severity should be chosen to be representative of the worst case likely to be encountered during the MTDS.

   c. Test Procedure. The test shall be conducted in accordance with AECTP 400 - Method 403.

4. HIGH TEMPERATURE CYCLING

a. Reason For Test. This test is conducted to demonstrate that the cannon ammunition will remain safe and serviceable after storage in temperate, hot humid or hot dry conditions.

b Information. The test may also be used to represent accelerated ageing (to be described in STANAG 4315 - when available). The test cycles will normally be selected from those specified in STANAG 2895. Each cycle will represent a 24 hour period. The cycles may be conducted with low humidity conditions, with controlled high humidity conditions, or with the effects of high solar radiation superimposed. Such cycles may be used to represent accelerated ageing where an assessment of the munition design indicates that high temperature cycling will cause appropriate deterioration. The selection of the cycles to be used, and the number of cycles to be applied, will depend upon assessment of the worst case in-service logistics of the munition and the amount of accelerated ageing to be represented. Account should be taken of any environmental protection (e.g. by container design) provided for the munition.

c. Test Procedure. The test shall be conducted in accordance with AECTP 300 - Method 302.

5. LOW TEMPERATURE CYCLING

a. Reason For Test. This test is conducted to demonstrate that the cannon ammunition will remain safe and serviceable after storage in cold conditions.

b Information. The test cycles will normally be selected from those specified in STANAG 2895. Such cycles may be used to represent accelerated ageing where an assessment of the munition design indicates that low temperature cycling will cause appropriate deterioration. The selection of the cycles to be used, and the number of cycles to be applied, will depend upon assessment of the worst case in-service logistics of the munition and the amount of accelerated ageing to be represented. Account should be taken of any environmental protection (e.g. by container design) provided for the munition.

c. Test Procedure. The test shall be conducted in accordance with AECTP 300 - Method 303.

6. LOW FREE FALL DROP

a. Reason For Test. This test is conducted to demonstrate that the packaged cannon ammunition will remain safe and serviceable following a low free fall drop.

b. Information. A study of the MTDS for the ammunition should determine the maximum height from which the test should be conducted (e.g. railcar, truck, VERTREP). The preferred figure is a minimum of 1.5 m. The ammunition specification should indicate whether the ammunition is required to remain safe for handling and disposal, or safe and suitable for service following the drop.

c. Test Procedure. The test shall be conducted in accordance with AECTP 400 - Method 403

7 UNDERWATER SHOCK

a. Reason For Test. These tests are conducted to demonstrate that the packaged cannon ammunition, when embarked in a naval or merchant vessel and subjected to the shock of underwater explosion, will not additionally hazard the vessel, and where appropriate will remain safe and suitable for service use.

b. Information. The shock level will vary according to the class of ship and the location of magazines and mountings. There are 2 levels of severity of test.

(1). Vessel Survival Safety. This is the more severe test level, set at the maximum underwater shock that the vessel can safely survive. This is used to determine that the ammunition remains safe for handling and disposal.

(2). Ammunition Survival for Service Use. This is the level of underwater shock at which the ammunition must survive and remain safe and suitable for service use. This test is to be conducted as part of the sequential trial.

c. Test Procedure. The tests shall be conducted in accordance with national procedures

8. PARACHUTE DELIVERY

a. Reason For Test. This test is conducted to demonstrate that the packaged cannon ammunition will remain safe and serviceable following a parachute delivery of a unit load.

b Information. If required by the MTDS, the packaged munition shall be prepared for air-dropping with other dummy weighted containers to represent a unit load on a shock absorbing base in accordance with national procedures. The preferred minimum drop height is 6 m, or as identified in AECP-1 (STANAG 2914).

c. Test Procedure. The test shall be conducted in accordance with national procedures.

9. RAIN

a. Reason For Test. This test is conducted to demonstrate that the packaged cannon ammunition will remain safe and serviceable following exposure to driving rain.

b Information. The parameters of the test are defined by rainfall intensity and duration.

c. Test Procedures. The test shall be conducted in accordance with AECTP 300 - Method 310.

10. SALT SPRAY

a. Reason For Test. This test is conducted to demonstrate that the cannon ammunition will remain safe and serviceable following exposure to a salt atmosphere.

b. Information. The salt solution used in the test should be representative of typical marine atmospheres. The severity of the test is determined by the spraying time and the subsequent storage conditions (temperature, humidity and duration). Apart from naval ammunition, this test is normally only conducted if metallic parts are exposed to the environment. In the naval case, consideration should be given to repeating the test for both packaged and unpackaged ammunition depending on whether the ammunition is exposed on the mounting.

c. Test Procedures. The test shall be conducted in accordance with AECTP 300 - Method 309.

11. DUST AND SAND

a Reason For Test. This test is conducted to demonstrate that the packaged cannon ammunition will remain safe and serviceable following exposure to blowing dust and sand.

b. Information. The test severity is determined by the particle size and concentration, the air velocity and the test duration.

c. Test Procedures. The test shall be conducted in accordance with AECTP 300 - Method 314.

12. CONTAMINATION BY FLUIDS

a. Reason For Test. This test is conducted to demonstrate that the cannon ammunition will remain safe and serviceable following exposure to fluids typical of those which may cause contamination in service.

b. Information. The range of fluids to be considered include fuels, oils, hydraulic fluids, solvents, cleaning fluids, battery electrolytes and nuclear, chemical or biological fall-out decontamination fluids. The fluids to be used and the severity parameters should be determined from the MTDS. Consideration should be given to the need to pre-heat some fluids to appropriate temperatures.

c Test Procedures. The test shall be conducted in accordance with national procedures.

13 SEALING

a. Reason For Test. This test is conducted to demonstrate that the cannon ammunition is serviceable after immersion.

b Information. The test may be conducted by immersing unpackaged ammunition in water and observing for the emergence of bubbles. The test criteria should indicate the proportion of rounds required to remain serviceable.

c. Test Procedures. The test shall be conducted in accordance with AECTP 300 - Method 307.

14. TACTICAL VIBRATION

a Reason For Test. This test is conducted to demonstrate that the cannon ammunition will remain safe and serviceable during operational carriage.

b. Information. The real environment is a mixture of random and sinusoidal vibration. Stowage and carriage on mountings in ships has a dominant sinusoidal component at low frequencies, whereas random vibration is more significant in fighting vehicles. Track patter is mainly random in nature but may have specific peak sine vibration at discrete frequencies. The vibration environment of external or internal carriage on fixed-wing aircraft is essentially random in nature. Rotorcraft will have random vibration with superimposed sinusoidal vibration at rotor frequencies. In some mountings with complex feed systems, rounds may be exposed to significant and repetitive gun shocks prior to being chambered for firing. The type of vibration testing selected must be chosen from the worst cases identified from the MTDS specified in the ammunition specification It may be necessary to carry out the selected vibration tests at appropriate high and/or low temperatures associated with specified areas for operational deployment, and to consider the effect of low air pressures associated with carriage at high altitude.

c. Test Procedure. Tests shall be conducted in accordance with AECTP 400 - Method 401.

15. HANDLING FREE FALL (UNPACKAGED)

a. Reason For Test. This test is conducted to demonstrate that the unpackaged cannon ammunition will remain safe following a free fall drop during handling.

b. Information. A study of the MTDS for the ammunition should determine the maximum height from which the test should be conducted. The minimum figure is 1 m The test criteria should indicate whether the ammunition is required to remain safe for handling and disposal, or safe and suitable for service following the drop. Rounds that have no visible damage shall be capable of being fired safely. Rounds that exhibit visible damage shall remain safe for handling and disposal.

c. Test Procedure. The test shall be conducted in accordance with AECTP 400 - Method 403.

16. ELECTROMAGNETIC RADIATION, ELECTROSTATIC DISCHARGE AND LIGHTNING

a. Reason For Test. This test is conducted to demonstrate that the cannon ammunition will remain safe and serviceable following exposure to various electrical and electromagnetic environments.

b. Information. Electromagnetic environments which the ammunition is expected to remain safe and suitable for service include the levels of electromagnetic radiation specified in STANAGs 1307 and 4234. Electromagnetic environments in which the ammunition is expected to remain safe include the severe

environments in STANAG 4234, electrostatic discharge levels specified in STANAG 4235 and lightning levels specified in STANAG 4236.

c. Test Procedures. The tests shall be conducted in accordance with STANAG 4324, 4239 (with AOP-24) and 4327 (with AOP-25) and national procedures.

17. NUCLEAR HARDENING

a. Reason For Test. This test or assessment is conducted to demonstrate that the cannon ammunition will remain safe, or safe and serviceable, following exposure to the effects of a nuclear explosion.

b. Information. The potentially damaging effects of a nuclear explosion are electromagnetic pulse (EMP), nuclear radiation, air blasts and thermal radiation as defined in STANAG 4145 (AEP-4) and AEP-22. Consideration should be given to severity levels of these effects at which the ammunition should remain safe, and severity levels at which the ammunition should remain safe and suitable for service.

c. Test Procedure. The test or assessment shall be conducted in accordance with STANAG 4416, AEP-9, AEP-18 and/or national procedures.

18. DOUBLE FEED

a. Reason For Test. This test is conducted to identify the potential safety hazard when one round is fed to impact another live round or fired case

b. Information. Only required if the design safety assessment of the cannon identifies such an event to be a credible accident. Typically this may occur if a live or fired round remains in the chamber (double feed or extraction failure).

c. Test Procedure. The test shall be conducted in accordance with national procedures.

19. FIRING

a. Reason For Test. These tests are conducted to demonstrate that the cannon ammunition is both safe and suitable for firing, (i.e. functions as designed)

b. Information. The tests should be conducted with service guns or test barrels in the first stage of their life unless otherwise indicated. The ammunition is fired to establish the functional reliability when new and after a full programme of environmental stressing. The effect of temperature and wear is established. The firing programme may include:

(1) Pressure and velocity tests (if not undertaken as part of the Propelling Charge Safety Test (See Annex A paragraph 3)).

(2) Firing at ambient temperature (if required).

(3) Firing hot conditioned ammunition.

(4) Firing cold conditioned ammunition.

(5) Ammunition cycling (feeding, loading, firing.....)

(6) Tracer functioning.

(7) Self destruct functioning.

(8) Fuze arming distance (See also Annex A paragraph 12)

(9) Proximity fuze functioning

(10) Time fuze functioning

(11) Fuze graze functioning.

(12) Accuracy firings to validate ballistic predictions and assess dispersion.

(13) Sabot/pusher fragment dispersion.

(14) Barrel wear and erosion rates for the specified firing cycle.

(15) Firing with a worn barrel.

(16) Firing with an obstructed barrel.

c. Test Procedures. The tests shall be conducted in accordance with national procedures.

20. PROPELLANT PERFORMANCE PREDICTABILITY

a. Reason For Test. This test is conducted to demonstrate that the propellant performance is predictable throughout the small variations in charge weight and composition, lot to lot, which are encountered during manufacture.

b. Information. The ammunition is loaded with various increments of charge weight, usually +2, +1, -1 (grams or %), from 2 production lots of propellant and fired through a pressure barrel. Pressure and muzzle velocity are recorded for each shot.

c. Test Procedure. The test should be conducted in accordance with national procedures.

21. CRITICAL EXAMINATION

a. Reason For Test. These tests are conducted to assess the effects of environmental stressing and artificial ageing on the cannon ammunition.

b. Information. The ammunition is examined to determine if any physical or chemical changes occur in the ammunition during the MTDS. The examination may include:

(1) Repeat sealing test (See Test 13 of Annex B).

(2) External condition - loadability.

(3) Bullet pull - measurement of the force required to extract the bullet from the cartridge.

(4) Propellant weight, moisture content and stabiliser content.

(5) Condition of other explosive compositions.

(6) Primer functioning and sensitiveness parameters.

(7) Primer Fire and No Fire thresholds and electrical resistance (where applicable).

(8) Fuze – condition of safety sensitive components (including, where appropriate, radiographic examination), functioning of explosive train.

(9) Metallurgical condition of cartridge case and projectile body (where appropriate).

(10) Physical condition and adherence of sabots, pushers and penetrators (where appropriate).

(11) The need to examine other features may be identified during environmental and firing tests.

c. Test Procedures. The tests shall be conducted in accordance with national procedures.

22. RANGE SAFETY

a. Reason For Test. These tests are conducted to identify the hazards produced by firing the cannon ammunition to be applied to the establishment of the Weapon Danger Area (WDA) and Noise/Toxic hazard areas.

b. Information. The tests are required to assess the dimensions of the WDA specified in STANAG 2401 [when promulgated] and hazard areas for land ranges, training areas and sea firings. Information on ballistic performance from range tables will be required. The following tests may be conducted:

(1) Burst safety distance (Explosively filled projectiles).

(2) Ricochet danger area (Inert and explosive projectiles)

(3) Levels of Toxic contaminants for range installation (See Test No 10 - Annex A).

(4) Noise for range installation configuration (See Test No 11 - Annex A).

c. Test Procedure. The tests shall be conducted in accordance with STANAG 2401, when promulgated, or national procedures.